

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2015 / 2016

PPH0135 - ELECTRICITY AND MAGNETISM

(Foundation in Engineering)

13 OCTOBER 2015

9.00 a.m. – 11.00 a.m.

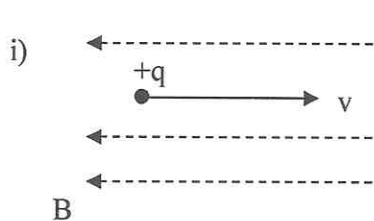
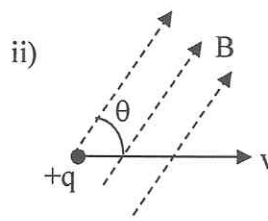
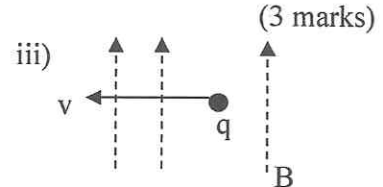
(2 Hours)

INSTRUCTIONS TO STUDENT

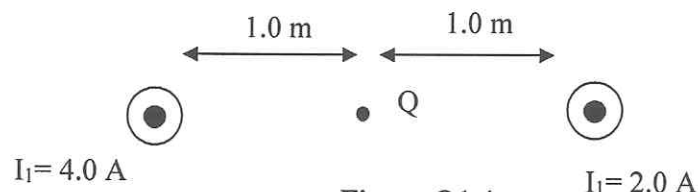
1. This question paper consists of **SIX (6)** printed pages excluding the cover page with **FOUR (4)** questions.
 2. Answer **ALL** questions. The distribution of the marks for each question is given.
 3. Please write all your answers in the answer booklet provided.
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QUESTION 1 (15 marks)

- a) Sketch the direction of magnetic field of a magnet bar. Label accordingly. (2 marks)
- b) Given the direction of magnetic field, B and motion of charge, v for each charge, q are as shown in **Figure Q1.1**, **Figure Q1.2** and **Figure Q1.3**. Determine the direction of resultant magnetic force (if any) exerted on each charge. You may copy the whole diagram into your answer script.

**Figure Q1.1****Figure Q1.2****Figure Q1.3**

- c) Under what circumstances do you use the following hand's rule ?
- Fleming's left hand rule
 - Right hand rule
- d) There are two conductors carries current I_1 and I_2 as shown in **Figure Q1.4**. Answer the following questions: (2 marks)

**Figure Q1.4**

- Copy the whole **Figure Q1.4** onto your answer script and sketch the direction of magnetic field produces by each conductor at point Q. Label accordingly. (2 marks)
- Calculate individual magnitude of magnetic field produces by each conductor at point Q. (2 marks)
- What law do you use to determine the answer in (ii) ? (1 mark)
- From (ii), determine the magnitude of net magnetic field at point Q. (1 mark)

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- e) Determine the direction of induced current (if any) produces in the loop, for the following **Figure Q1.5**. Explain your answer.

(2 marks)

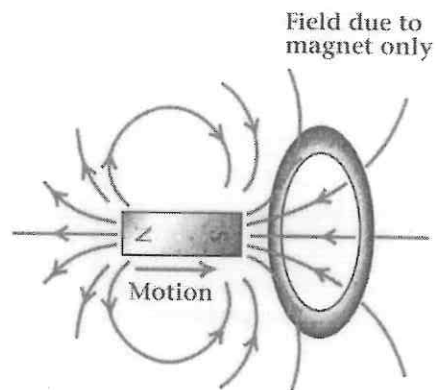
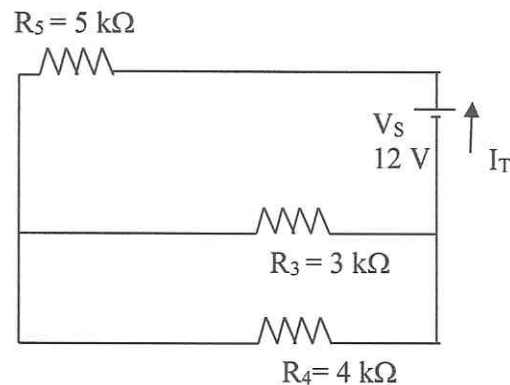


Figure Q1.5

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QUESTION 2 (15 marks)**Figure Q2.1**

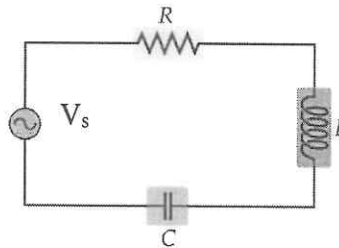
Answer the following questions based on **Figure Q2.1**:

- Copy **Figure Q2.1** onto your answer script and show direction of all currents flow across each resistors. Label accordingly. (3 marks)
- Combine resistors R_3 and R_4 , R_{34} . (1 mark)
- Using voltage divider rule, calculate voltage across R_{34} , V_{34} and voltage across R_5 , V_5 . (2 marks)
- From (c), determine the total current flows, I_T , across R_5 . (1 mark)
- From (d), using current divider rule, calculate currents across R_3 , I_3 and across R_4 , I_4 . (2 marks)
- Using Kirchhoff Current Law and any values found in previous calculations, verify the current flows across R_5 , I_T found in (d). (1 mark)
- Using Thevenin's method, determine Thevenin's voltage, V_{Th} and Thevenin's resistance, R_{Th} if load resistor is R_3 . (2 marks)
- Sketch Thevenin's equivalent circuit based on the answer found in (g). Thus verify the current flows across R_3 , I_3 found in (e). (2 marks)
- Determine Norton's resistance, R_N if load resistor is R_3 . (1 mark)

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QUESTION 3 (10 marks)

Figure Q3.1 shows a series RCL circuit has a $100.0\ \Omega$ resistor, a $200.0\ \mu\text{F}$ capacitor and a $300.0\ \text{mH}$ inductor connected across an ac generator operating at $50.0\ \text{Hz}$ and voltage source of $75.0\ \text{V}$.

**Figure Q3.1**

- a) Determine the reactance of inductor (X_L) and capacitor (X_C). (2 marks)
- b) Determine the impedance, Z of the whole circuit. (1 mark)
- c) From (b), determine the total current across the whole circuit, I_T . (1 mark)
- d) Sketch a phasor diagram showing reactance of inductor as well as capacitor, resistance and impedance of the circuit. (2 marks)
- e) Determine the power factor, $\cos \phi$. (1 mark)
- f) Obtain apparent power, reactive power and average power for this circuit. (3 marks)

QUESTION 4 (10 marks)

- a) Differentiate the term valence band and conduction band. (2 marks)
- b) i) What type of material be added into semiconductor material in order to produce P-type semiconductor? (1 mark)
- ii) Sketch the atomic structure which explaining your reason in (i). (2 marks)
- c) Sketch a simple graph of current versus voltage, showing diode characteristic during both forward and reverse bias. (2 marks)
- d) Sketch schematic symbol for PNP transistor and label the direction of currents across each terminal. (2 marks)
- e) How many PN junctions are there for a PNP transistor? (1 mark)

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APPENDIX I

Physical Constants

Quantity	Symbol	Value
Electron mass	m_e	$9.11 \times 10^{-31} \text{ kg}$
Proton mass,	m_p	$1.67 \times 10^{-27} \text{ kg}$
Elementary charge	e	$1.602 \times 10^{-19} \text{ C}$
Gravitational constant	G	$6.67 \times 10^{-11} \text{ N.m}^2/\text{kg}^2$
Gas constant	R	8.314 J/K.mol
Hydrogen ground state	E_0	-13.6 eV
Boltzmann's constant	k_B	$1.38 \times 10^{-23} \text{ J/K}$
Compton wavelength	λ_c	$2.426 \times 10^{-12} \text{ m}$
Planck's constant	h	$6.626 \times 10^{-34} \text{ J.s}$
Speed of light in vacuum	c	$3.0 \times 10^8 \text{ m/s}$
Rydberg constant	R_H	$1.097 \times 10^7 \text{ m}^{-1}$
Acceleration due to gravity,	g	9.81 m/s^2
Atomic mass unit (1u)	u	$1.66 \times 10^{-27} \text{ kg}$
Avogadro's number	N_A	$6.023 \times 10^{23} \text{ mol}^{-1}$
Threshold of intensity of hearing	I_0	$1.0 \times 10^{-12} \text{ W/m}^2$
Coulomb constant	k	$8.988 \times 10^9 \text{ N.m}^2/\text{C}^2$
Permittivity of free space	ϵ_0/κ_0	$8.85 \times 10^{-12} \text{ C}^2/\text{N.m}^2$
Permeability of free space	μ_0	$4\pi \times 10^{-7} \text{ H/m}$

Energy equivalent of atomic mass unit:

One atomic mass unit (1.0 u) is equivalent to 931.5 MeV

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APPENDIX II

List of formulas

$$A_v = \frac{V_c}{V_b}$$

$$\alpha_{dc} = \frac{\beta_{dc}}{\beta_{dc} + 1}$$

$$\beta_{dc} = \frac{\alpha_{dc}}{1 - \alpha_{dc}}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B = \mu_0 n I$$

$$\xi = V + Ir$$

$$\xi = blv$$

$$\xi = -N \frac{\Delta\Phi}{\Delta t}$$

$$\xi = -L \frac{dI}{dt}$$

$$\xi = -M \frac{dI}{dt}$$

$$F = BIL \sin \theta$$

$$F = qvB \sin \theta$$

$$\frac{F}{\ell} = \frac{\mu_0 I_1 I_2}{2\pi d}$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$I_{\text{tot}} = \sqrt{I_R^2 + (I_L - I_C)^2}$$

$$I = neA(v_n + v_p)$$

$$I = nev_d A$$

$$I = I_{\text{max}} \sin \omega t$$

$$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}}$$

$$I_x = \left(\frac{R_T}{R_x} \right) I_T$$

$$L = \frac{N\Phi_B}{I}$$

$$L = \frac{\mu_0 N^2 A}{l}$$

$$M = \frac{N\Phi_B}{I}$$

$$M = \frac{\mu_0 N_1 N_2 A}{l}$$

$$P = IV = I^2 R = \frac{V^2}{R}$$

$$P_t = I_{\text{rms}} V_{\text{rms}} \cos \phi$$

$$P_r = V_{\text{rms}} I_{\text{rms}} \sin \phi$$

$$P_a = I_{\text{rms}}^2 Z$$

$$R = \frac{\rho L}{A}$$

$$R = R_0 [1 + \alpha(T - T_0)]$$

$$R_T = R_1 + R_2 + R_3 + \dots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

$$r = \frac{mv}{Bq}$$

$$\tau = NBIa \sin \theta$$

$$U = \frac{1}{2} LI^2$$

$$U = \frac{1}{2} B^2 A \frac{l}{\mu_0}$$

$$V_H = Bvd$$

$$V = V_{\text{max}} \sin \omega t$$

$$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$$

$$V_x = \left(\frac{R_x}{R_T} \right) V_s$$

$$X_C = \frac{1}{2\pi f C}$$

$$X_L = 2\pi f L$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\oint B \cdot dl = \mu_0 I$$

$$d\mathbf{B} = \frac{\mu_0 I}{4\pi} \frac{d\ell \times \hat{r}}{r^2}$$

$$\Phi_B = BA \cos \theta$$

$$\cos \phi = \frac{R}{Z}$$

$$\tan \phi = \frac{X_L - X_C}{R}$$